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ON THE

EARTH STATION INTERFACE

FOR

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1. Introduction

The High Speed Burst Modem (LBM36A) processes data from the Interface Control and Codec Unit (LCC36A) and the Western Union Earth Station. The high bandwidth signal processing tasks, such as modulation, demodulation, preamble detection, etc., are primarily performed by special purpose hardware. The microprocessor is primarily designed to perform controlling and monitoring functions.

The LBM36A is a functional enhancement of the LBM36 burst modem. Due to the nature of the enhancements, additional software must be created and integrated into the general structure. This can be done most clearly by modifying the LBM36 software structure from its present dual path format to a simpler one path structure. The LBM36A must perform all the previously mentioned functions in a manner identical to the LBM36. In addition, it must perform uplink tuning, downline loading, enhanced built-in-test, and other functions. This quarterly technical report will compare the LBM36 and the LBM36A software structures.

Section 2 will describe the software structure used in the LBM36 which was delivered in the fall of 1982. Sect. will describe the functional enhancements and the software str..ture of the LBM36A.

2. LBM36 Software Structure

The major functions of the microprocessor are as follows:

a. Control and monitor the Interface Control and Codec (ICCU) interface.

b. Control and monitor the Western Union interface.

c. Control the front panel indicators

d. Control the gross frequency acquisition and the automatic frequency control (AFC).

e. control the acquisition power level and the automatic gain control (AGC).

f. Monitor the modem faults.

g. Generate test data and gather statistical data on modem and channel performance.

h. Control the built in tests and monitor results.

i. Initialize the modem and control the operational parameters.

The LBM36 has two primary modes of operations inline and debug. The inline mode is used when the modem is functioning as part of the ESI in the network. When inline the modem accepts commands from the ICCU interface only. The debug mode allows the modem to function as a burst test modem (BTM). A video terminal and the front panel can cause the processor to exit to the debug mode, which then accepts commands from the terminal and front panel, otherwise they have no effect. The ICCU can cause an exit only to the inline mode.

The following pages include a structured english description of the code in the LBM36.

POWER ON RESET

Initialize the stack pointers.
Initialize front panel variables.
If the front panel is present, initialize the front panel.
If there is no front panel, run from Inline Initialize.
If the front panel is present and the modem is in inline mode, run from Inline Initialize; otherwise, run front Debug Initialize.

INLINE INITIALIZE

Initialize some modem parameters.

Initialize the PIA (modem <---> ICCU interface.)
Initialize the ACIA (modem <---> video terminal.
Initialize the UIA (interrupt controller).
Initialize the PTM (programmable timer).
Initialize the modem hardware.
Run from Inline Suspense.

INLINE SUSPENSE

Update the watchdog timer.
Process front panel inputs, if any.
Process ACIA commands, if any.
If the ICCU acknowledges, run from Inline Start.
Otherwise, run from the start of this routine.

INLINE START

Initialize the modem-ICCU queue pointers.
Initialize the modem for operation.
Run from Inline Main.

INLINE MAIN

Update the watchdog timer.
Perform AFC.
Perform AGC.
Process front panel commands, if any.
Process ACIA commands, if any.
Process ICCU inputs, if any.
Process ICCU commands, if any.
Run from the start of this routine.

The following commands are possible while in inline mode:

ICCU COMMANDS

Reset processor soft, hard, soft and pointers.
Set frequency TXIF, RXIF, RX VCXO.
Set symbol rate.
Set modem mode, txenable, rxenable.
Set loopback mode.
Set preamble detect mode.
Set agc level.
Enable T&M data.
Acquire/track.

FRONT PANEL COMMANDS

Change mode to:
TX/RX Test
RxTest
BIT

VIDEO TERMINAL COMMANDS

Change mode to TX/RX Test

The following interrupts are possible while in inline mode:

Hard reset from ICCU.
Front panel interrupt:
  queue input commands.
Start of burst interrupt:
  count number of bursts.
End of receive burst interrupt:
  set flag to perform AFC, AGC;
  send T&M data if enabled.

DEBUG INITIALIZE

Initialize some modem parameters.
Initialize the PIA.
Initialize the ACIA.
Initialize the UIA.
Initialize the PTM.
Initialize modem hardware.
Run from Debug Main.

DEBUG MAIN

Update the watchdog timer.
Process ACIA inputs, if any.
Process ACIA commands, if any.
Process front panel inputs, if any.
Perform AFC.
Perform AGC.
Run from the start of this routine.

The following commands are possible while in debug mode:

ICCU COMMANDS

Hard reset.

VIDEO TERMINAL COMMANDS

All ICCU commands possible while in inline mode plus:
Set burst spacing, length, modulation type, symbol rate and data pattern.
Read memory.

FRONT PANEL COMMANDS

Set operating mode:

Inline
Tx/Rx test
Rx test

BIT

Start/stop.
Set modem status:

Modulation type
Data pattern
Burst length
Burst spacing
Symbol rate
#TX bursts
TX IF frequency
RX IF frequency
Acquire /no acquire

Read modem parameters:

bit error rate
errors
TX bursts
RX bursts
Eb/No
Carrier power

DEBUG INTERRUPTS

Front panel:
  queue up front panel commands.
I errors:
  increment error counters,
Q errors:
  increment error counters.
End of transmit burst:
  count transmit bursts.
Start of receive burst:
  count receive bursts.
End of receive burst:
  set flag to perform AFC, AGC.
Timer #3:
  increment interval counter (for continuous mode).
Timer #2:
  Update front panel display.

3. LBM36A

The LBM36A is a functional enhancement of the LBM36 burst modem. Due to the nature of the enhancements, additional software must be created and integrated into the general structure. This can be done most clearly by modifying the LBM36 software structure from its present dual path format to a simpler one path structure. The LBM36A must perform all the previously mentioned functions in a manner identical to the LBM36. In addition, it must perform uplink tuning, downline loading, enhanced built-in-test, and other functions as detailed in section 3.1. The software structure is described in section 3.2..

3.1. Functional Enhancements

1. *Downline Loading - The LBM36A employs EEPROM memory* for main program storage. This memory can be rewritten while in the system, but is also non-volatile to preserve memory in the powered down state. It is possible to download to this memory using either the RS232 interface or the ICCU interface. Initially only the RS232 interface will be supported.

2. Built-In-Test - The preamble detect, DTX/RX Control, and the processor include hardware support for built-in-test in the enhanced system. Built-in-test is performed using signature analysis with a 16-bit word. The word can be read by the processor to evaluate performance. In addition, the processor is capable of extended RAM testing, by writing and reading known patterns. The PROM will be tested by reserving two bytes for a checksum of the contents of each prom. *The IBUS and OBUS interfaces can be tested by looping* the OBUS back to the IBUS.

3. Uplink Tuning - The enhanced synthesizer/mixer board provides a VCXO in the uplink path. This VCO will be tuned so that when set at the mid-point value normal operation results. By adjusting the setting, the uplink can be tuned to ±25 KHz. The algorithms for implementing uplink tuning will be determined from the results of the relevant study.

4. Active system testing - Active system testing entails use of the BTM or system burst modem to transmit data for use in evaluating channel performance. This data must not be received by the system downlink in order to prevent errors. In addition, it is possible to monitor channel Eb/No, noise level and frequency offset burst modem.

5. End-Of-Message - Various end-of-message detection schemes are possible, including use of carrier detection. The modem will not be able to terminate the burst itself, but it provides thresholding and bandwidth control so the ICCU can do so. Other end-of-message schemes will probably also require software in the HSBM.

6. Enhanced T&M - Additional T&M data should be sent, if enabled, including noise floor and receive power level. Two T&M modes must then exist, one with enhanced T&M, one without.

7. Quantization - Soft-decision quantization level can be adjusted for channel characteristics and symbol rate, based on instructions from the ICCU or an internal mechanism.

8. Remote Operation - In order to reduce the expense and time loss involved in system maintenance, and to use resources more fully, it is desirable to be able to fully operate the LBM36A remotely using the RS232 interface and a modem. Software must be modified to enable all front panel commands to be implemented using the terminal. Terminal display of modem-ICCU communications may also be desirable. In conjunction with this, a monitor is to be integrated with the software to allow more powerful debugging operations.

9. Data Scrambling - The processor allows scrambling of transmitted data, and descrambling of receive data, to reduce system sensitivity to all ones or all zeros data. Use of scrambling involves a change in the modem backplane, so that scrambling will not be able to be used in old systems.

10. Other features - Other, minor modifications include better error messages, a front panel initiated reset and more choices of burst length, spacing, and data patterns while in test mode.

3.2. Software Structure

The LBM36A incorporates all the features of the LBM36. In addition, the enhancements mentioned above must be integrated into the software. In order to accomplish this, it is desirable to modify the structure of the software from the dual path structure of the LBM36 to a single path structure. this will enable various features to be accommodated in a simpler manner.

The modem, upon power-on reset, is initialized according to the front panel mode. The AGC circuit and the frequency synthesizers are calibrated and BIT is performed, except in inline mode. In inline mode, the modem will respond to some front panel commands, and all video terminal commands. In test mode, the modem will respond to all front panel and video terminal commands.

The video terminal will be able to command the front panel mode, and read the front panel status, in addition to using the modem-ICCU commands and the monitor commands which will be identified by an "M" prefixed to the command. Front panel commands will be prefixed by a "P". Modem-ICCU commands will remain unprefixed.

Inputs from the ICCU and transfers to and from the video terminal will be processed using interrupts. Output data to the terminal will be queued in three queues, one for each source (Video terminal ICCU, and Modem Front Panel). Only when one queue is empty will the next queue be processed.

The basic structure is as follow:

POWER ON RESET

Initialize the stack pointers.
Initialize the front panel, if present.
Initialize modem parameters.
Initialize the ACIA.
Initialize the PTMs.
Initialize the UIC.
Initialize the modem hardware.
Check for LTCLK present.
Initialize the IBUS interface.
Run from initialize.

INITIALIZE

Perform BIT, unless in inline.
Run from Main Loop.

MAIN LOOP

Update the watchdog timer.
Perform AFC.
Perform AGC.
Perform uplink tuning.
Process ICCU commands, if any.
Process ACIA commands, if any.
Process front panels commands, if any.
Run from the start of this routine.

BIT

Perform UEPROM checksum.
Perform EEPROM checksum.
Perform RAM test.
Perform IBUS-OBUS test.
Preform timer test.
Perform processor signature test.
Test preamble detect.
Test DTx/Rx control.
Test baseband loopback operation.
Calibrate VCO and AGC.
Test IF loopback operation.

DOWNLINE LOADING

Get parameters: memory start, memory end
(Up to 4K bytes)
Read data, store in RAM, perform checksum
(Motorola hex)
Copy block into EEPROM, perform checksum
Send acknowledge

INTERRUPTS

End of receive burst:

Prepare for AFC, if not queued
Prepare for AGC, if not queued
Prepare for uplink tuning, if enabled
Send T&M data, if enabled (raise the T&M enable signal).

End of Tx burst

Count a burst.

Ierror

Increment error count, except in inline (disable interrupt)

Oerror

Increment error count, except in inline (disable interrupt)

Start of receive burst

Count a burst.

Timer 2

Update channel statistics
Blink display

Timer 1

Count time intervals.

Front Panel

If start/stop, stop BIT (if in BIT) and go to operating mode.
If change of mode, change operating mode.
If modem reset (3 resets, then 1 enter), perform hard reset.

Otherwise, put command in queue.

IBUS

Read IBUS command, put in queue

ACIA

Read new byte, put in queue, echo.
Count number of returns in queue.
Write any byte in queue.
If none, disable interrupt for empty Tx buffer.

NMI

Watchdog timer.

New ICCU - Modem Commands

Enable/disable enhanced T&M (test and monitoring).
Enable/disable uplink tuning.
Enable/disable data scrambling.
Perform BIT.
Change quantization level.

New Modem - ICCU Messages

Watchdog error, various error messages.
More T&M data, if enabled.

Front Panel Options

Change loopback mode: AUX, AUX
Calibrate VCXO.

New Terminal Commands

Monitor commands: M-.
Front panel command: P-. The next front panel display contents will also come to the terminal.
Display front panel status: Will display all writes to the font panel until disabled.
Display ICCU-Modem status: will display all Modem-ICCU interactions, until disabled.